

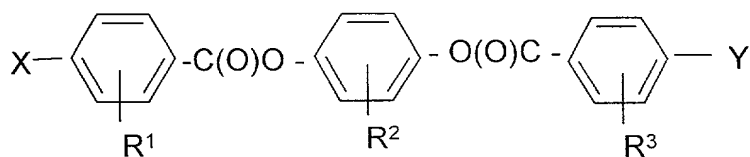
I Claim:

1. A method for producing a blend comprising randomly substituted mesogens, said method comprising:

providing one or more platform molecules comprising terminal substituents X and Y; and

independently substituting a polymerizable group for at least one member selected from the group consisting of X and Y, thereby producing a blend of randomly substituted mesogens;

wherein said platform molecules have the following general structure:



wherein X and Y are independently selected from the group consisting of terminal functionalities and spacer groups;

R^2 is a bulky organic group whereby, when both X and Y are reacted polymerizable groups to produce polymerizable mesogens, R^2 provides sufficient steric hindrance to achieve a nematic state at room temperature while suppressing crystallinity of said polymerizable mesogens at room temperature;

R^1 and R^3 are selected from groups less bulky than R^2 .

2. The method of claim 1 wherein X comprises a terminal functionality and Y comprises a polymerizable group in about 50 wt% or more of said blend.

3. The method of claim 1 wherein X comprises a terminal functionality and Y comprises a polymerizable group in about 60 wt.% of said blend.

1 4. The method of claim 1 wherein X comprises a terminal functionality
2 and Y comprises a polymerizable group in about 70 wt.% of said blend.

1 5. The method of claim 1 wherein said polymerizable groups are selected
2 from the group consisting of acryloyloxy groups, methacryloyloxy groups, and
3 acryloyloxy alkoxy and methacryloxyalkyloxy groups comprising an alkyl moiety
4 having from about 2 to about 12 carbon atoms and comprising CH₂ groups, wherein
5 one or more of said CH₂ groups independently can be substituted by oxygen, sulfur,
6 or an ester group; provided that at least 2 carbon atoms separate said oxygen or said
7 ester group.

1 6. The method of claim 2 wherein said polymerizable groups are selected
2 from the group consisting of acryloyloxy groups, methacryloyloxy groups, and
3 acryloyloxy alkoxy and methacryloxyalkyloxy groups comprising an alkyl moiety
4 having from about 2 to about 12 carbon atoms and comprising CH₂ groups, wherein
5 one or more of said CH₂ groups independently can be substituted by oxygen, sulfur,
6 or an ester group; provided that at least 2 carbon atoms separate said oxygen or said
7 ester group.

1 7. The method of claim 4 wherein said polymerizable groups are selected
2 from the group consisting of acryloyloxy groups, methacryloyloxy groups, and
3 acryloyloxy alkoxy and methacryloxyalkyloxy groups comprising an alkyl moiety
4 having from about 2 to about 12 carbon atoms and comprising CH₂ groups, wherein
5 one or more of said CH₂ groups independently can be substituted by oxygen, sulfur,
6 or an ester group; provided that at least 2 carbon atoms separate said oxygen or said
7 ester group.

1 8. The method of claim 1 wherein said polymerizable groups are selected

2 from the group consisting of cinnamoyloxy groups, acryloyloxy groups,
3 methacryloyloxy groups, and acryloyloxy alkoxy and methacryloyloxy alkoxy groups
4 comprising an alkyl moiety having from about 2 to about 12 carbon atoms, thiol
5 alkoxy groups comprising an alkyl moiety having from about 2 to about 12 carbon
6 atoms, said alkyl moiety comprising CH₂ groups, wherein one or more of said CH₂
7 groups independently can be substituted by oxygen, sulfur, or an ester group;
8 provided that at least 2 carbon atoms separate said oxygen or said ester group.

1 9. The method of claim 2 wherein said polymerizable groups are selected
2 from the group consisting of cinnamoyloxy groups, acryloyloxy groups,
3 methacryloyloxy groups, and acryloyloxy alkoxy and methacryloyloxy alkoxy groups
4 comprising an alkyl moiety having from about 2 to about 12 carbon atoms, thiol
5 alkoxy groups comprising an alkyl moiety having from about 2 to about 12 carbon
6 atoms, said alkyl moiety comprising CH₂ groups, wherein one or more of said CH₂
7 groups independently can be substituted by oxygen, sulfur, or an ester group;
8 provided that at least 2 carbon atoms separate said oxygen or said ester group.

1 10. The method of claim 4 wherein said polymerizable groups are selected
2 from the group consisting of cinnamoyloxy groups, acryloyloxy groups,
3 methacryloyloxy groups, and acryloyloxy alkoxy and methacryloyloxy alkoxy groups
4 comprising an alkyl moiety having from about 2 to about 12 carbon atoms, thiol
5 alkoxy groups comprising an alkyl moiety having from about 2 to about 12 carbon
6 atoms, said alkyl moiety comprising CH₂ groups, wherein one or more of said CH₂
7 groups independently can be substituted by oxygen, sulfur, or an ester group;
8 provided that at least 2 carbon atoms separate said oxygen or said ester group.

1 11. The method of claim 1 wherein said polymerizable groups are selected

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2 from the group consisting of acryloyloxy alkoxy groups and methacryloyloxy alkoxy
3 groups.

1 12. The method of claim 2 wherein said polymerizable groups are selected
2 from the group consisting of acryloyloxy alkoxy groups and methacryloyloxy alkoxy
3 groups.

1 13. The method of claim 4 wherein said polymerizable groups are selected
2 from the group consisting of acryloyloxy alkoxy groups and methacryloyloxy alkoxy
3 groups.

1 14. The method of claim 1 wherein said polymerizable groups are
2 methacryloyloxy alkoxy groups.

1 15. The method of claim 2 wherein said polymerizable groups are
2 methacryloyloxy alkoxy groups.

1 16. The method of claim 4 wherein said polymerizable groups are
2 methacryloyloxy alkoxy groups.

1 17. The method of claim 1 wherein said terminal functionalities are
2 selected from the group consisting of hydroxyl groups, amino groups, sulfhydryl
3 groups, halogen atoms, alkoxy groups, and spacer groups.

1 18. The method of claim 2 wherein said terminal functionalities are
2 selected from the group consisting of hydroxyl groups, amino groups, sulfhydryl
3 groups, halogen atoms, alkoxy groups, and spacer groups.

1 19. The method of claim 4 wherein said terminal functionalities are
2 selected from the group consisting of hydroxyl groups, amino groups, sulfhydryl
3 groups, halogen atoms, alkoxy groups, and spacer groups.

1 20. The method of claim 5 wherein said terminal functionalities are

2 selected from the group consisting of hydroxyl groups, amino groups, sulfhydryl
3 groups, halogen atoms, alkoxy groups, and spacer groups.

1 21. The method of claim 6 wherein said terminal functionalities are
2 selected from the group consisting of hydroxyl groups, amino groups, sulfhydryl
3 groups, halogen atoms, alkoxy groups, and spacer groups.

1 22. The method of claim 7 wherein said terminal functionalities are
2 selected from the group consisting of hydroxyl groups, amino groups, sulfhydryl
3 groups, halogen atoms, alkoxy groups, and spacer groups.

1 23. The method of claim 8 wherein said terminal functionalities are
2 selected from the group consisting of hydroxyl groups, amino groups, sulfhydryl
3 groups, halogen atoms, alkoxy groups, and spacer groups.

1 24. The method of claim 9 wherein said terminal functionalities are
2 selected from the group consisting of hydroxyl groups, amino groups, sulfhydryl
3 groups, halogen atoms, alkoxy groups, and spacer groups.

1 25. The method of claim 10 wherein said terminal functionalities are
2 selected from the group consisting of hydroxyl groups, amino groups, sulfhydryl
3 groups, halogen atoms, alkoxy groups, and spacer groups.

1 26. The method of claim 11 wherein said terminal functionalities are
2 selected from the group consisting of hydroxyl groups, amino groups, sulfhydryl
3 groups, halogen atoms, alkoxy groups, and spacer groups.

1 27. The method of claim 13 wherein said terminal functionalities are
2 selected from the group consisting of hydroxyl groups, amino groups, sulfhydryl
3 groups, halogen atoms, alkoxy groups, and spacer groups.

1 28. The method of claim 14 wherein said terminal functionalities are

2 selected from the group consisting of hydroxyl groups, amino groups, sulfhydryl
3 groups, halogen atoms, alkoxy groups, and spacer groups.

1 29. The method of claim 16 wherein said terminal functionalities are
2 selected from the group consisting of hydroxyl groups, amino groups, sulfhydryl
3 groups, halogen atoms, alkoxy groups, and spacer groups.

1 30. The method of claim 21 wherein said terminal functionalities are
2 selected from the group consisting of hydroxyl groups, amino groups, sulfhydryl
3 groups, halogen atoms, alkoxy groups, and spacer groups.

1 31. The method of claim 1 wherein said blend has a T_c is from about 20 °C
2 to about 37 °C.

1 32. The method of claim 2 wherein said blend has a T_c is from about 20 °C
2 to about 37 °C.

1 33. The method of claim 5 wherein said blend has a T_c is from about 20 °C
2 to about 37 °C.

1 34. The method of claim 6 wherein said blend has a T_c is from about 20 °C
2 to about 37 °C.

1 35. A method comprising:
2 mixing a primary polymerizable mesogen comprising a primary nematic to
3 isotropic transition temperature ($T_{n \rightarrow \text{isotropic}}$) with an amount of a
4 secondary polymerizable mesogen comprising a secondary $T_{n \rightarrow \text{isotropic}}$,
5 greater than said primary $T_{n \rightarrow \text{isotropic}}$ to produce a mixture having a
6 curing temperature (T_c) sufficiently low to avoid discomfort during
7 dental procedures;

8 wherein said amount of said secondary polymerizable mesogen is effective to

9 increase said mixture $T_{n \rightarrow \text{isotropic}}$ to a temperature greater than said
10 primary $T_{n \rightarrow \text{isotropic}}$ and to maintain a sufficient difference (ΔT) between
11 T_c and said mixture $T_{n \rightarrow \text{isotropic}}$ to produce a polymerization shrinkage
12 of about 3 vol% change or less.

1 36. The method of claim 35 wherein said polymerization shrinkage is
2 about 2 vol% change or less.

1 37. The method of claim 35 wherein said primary polymerizable mesogen is
2 bis-(4-(6-methacryloyloxy-A-1-oxy)benzoyl)2-(t-butyl) quinone in which A is
3 selected from the group consisting of a alkyl groups having from about 2-9 carbon
4 atoms and mixtures thereof.

1 38. The method of claim 37 wherein A is a hexyl group.

1 39. A method comprising:
2 mixing a primary polymerizable mesogen comprising a primary nematic to
3 isotropic transition temperature ($T_{n \rightarrow \text{isotropic}}$) with an amount of a
4 secondary polymerizable mesogen comprising a secondary $T_{n \rightarrow \text{isotropic}}$
5 greater than said primary $T_{n \rightarrow \text{isotropic}}$ to produce a mixture having a
6 curing temperature (T_c) sufficiently low to avoid discomfort during
7 dental procedures;

8 wherein said secondary polymerizable mesogen is selected from the group
9 consisting of polymerizable elongated mesogens and mesogenic
10 dimers and said amount of said secondary polymerizable mesogen is
11 effective to increase said mixture $T_{n \rightarrow \text{isotropic}}$ to a temperature greater
12 than said primary $T_{n \rightarrow \text{isotropic}}$ and to maintain a sufficient difference

13 (ΔT) between T_c and said mixture $T_{n \rightarrow \text{isotropic}}$ to produce a
 14 polymerization shrinkage of about 3 vol.% change or less.

1 40. The method of claim 39 wherein said polymerization shrinkage is
 2 about 2 vol.% change or less.

1 41. The method of claim 40 wherein said primary polymerizable mesogen
 2 is bis-(4-(6-methacryloyloxy-A-1-oxy)benzoyl)2-(t-butyl) quinone in which A is
 3 selected from the group consisting of a alkyl groups having from about 2-9 carbon
 4 atoms and mixtures thereof.

1 42. The method of claim 39 wherein A is a hexyl group.

1 43. The method of claim 39 wherein said secondary polymerizable mesogen
 2 is a mesogenic dimer.

1 44. The method of claim 41 wherein said secondary polymerizable mesogen
 2 is a mesogenic dimer.

1 45. The method of claim 43 wherein said mesogenic dimer is decanedioic
 2 acid bis-(4-{2-tert-butyl-4-[4-(2-methyl-acryloyloxy)-benzoyloxy]-
 3 phenoxy-carbonyl}-phenyl) ester {C0[H,TB,H] (MeAcry)(O) }₂ (seb).

1 46. The method of claim 39 wherein said T_c is from about 20 °C to about 37
 2 °C.

1 47. The method of claim 40 wherein said T_c is from about 20 °C to about 37
 2 °C.

1 48. The method of claim 41 wherein said T_c is from about 20 °C to about 37
 2 °C.

3 49. The method of claim 42 wherein said T_c is from about 20 °C to about 37
 4 °C.

1 50. The method of claim 43 wherein said T_c is from about 20 °C to about 37
2 °C.

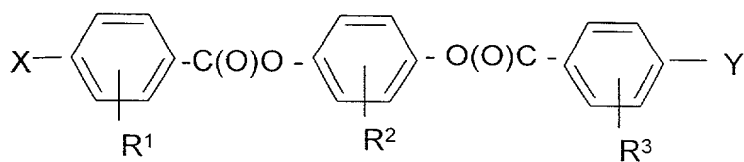
1 51. The method of claim 44 wherein said T_c is from about 20 °C to about 37
2 °C.

1 52. The method of claim 45 wherein said T_c is from about 20 °C to about 37
2 °C.

1 53. A method comprising mixing:
2 a quantity of bis-(4-(6-methacryloyloxy-A-1-oxy)benzoyl)2-(t-butyl) quinone
3 in which A is selected from the group consisting of alkyl groups
4 having from about 2-9 carbon atoms and comprising a primary nematic
5 to isotropic transition temperature ($T_{n \rightarrow \text{isotropic}}$); and
6 an amount of decanedioic acid bis-(4-{2-tert-butyl-4-[4-(2-methyl-
7 acryloyloxy)-benzoyloxy]-phenoxy-carbonyl}-phenyl) ester
8 {C0[H,TB,H] (MeAcry)(O) }₂ (seb) to produce a mixture comprising a
9 mixture $T_{n \rightarrow \text{isotropic}}$ that is sufficiently greater than said primary $T_{n \rightarrow \text{isotropic}}$
10 to maintain a sufficient difference (ΔT) between T_c and said
11 mixture $T_{n \rightarrow \text{isotropic}}$ to produce a polymerization shrinkage of about 3
12 vol% change or less.

1 54. The method of claim 53 wherein said polymerization shrinkage is about 2
2 vol% change or less.

1 55. A composition comprising mesogens having the following general
2 structure:



wherein

R^2 is a bulky organic group whereby, when both X and Y are reacted polymerizable groups to produce polymerizable mesogens, R^2 provides sufficient steric hindrance to achieve a nematic state at room temperature while suppressing crystallinity of said polymerizable mesogens at room temperature;

R^1 and R^3 are selected from groups less bulky than R^2 ; and

X and Y independently are selected from the group consisting of terminal functionalities and polymerizable groups, about 50 wt% or more of X and Y are polymerizable groups.

56. The composition of claim 55 wherein about 60 wt.% or more of X and Y are polymerizable groups.

57. The composition of claim 55 wherein about 70 wt.% or more of X and Y are polymerizable groups.

58. The method of claim 55 wherein said polymerizable groups are selected from the group consisting of selected from the group consisting of acryloyloxy groups, methacryloyloxy groups, and acryloyloxy alkoxy groups and methacryloxy alkyloxy groups comprising an alkyl moiety having from about 2 to about 12 carbon atoms and comprising CH_2 groups, wherein one or more of said CH_2 groups independently can be substituted by oxygen, sulfur, or an ester group; provided that at least 2 carbon atoms separate said oxygen or said ester group.

1 59. The method of claim 56 wherein said polymerizable groups are
2 selected from the group consisting of selected from the group consisting of
3 acryloyloxy groups, methacryloyloxy groups, and acryloyloxy alkoxy groups and
4 methacryloxy alkyloxy groups comprising an alkyl moiety having from about 2 to
5 about 12 carbon atoms and comprising CH₂ groups, wherein one or more of said CH₂
6 groups independently can be substituted by oxygen, sulfur, or an ester group;
7 provided that at least 2 carbon atoms separate said oxygen or said ester group.

1 60. The method of claim 57 wherein said polymerizable groups are
2 selected from the group consisting of selected from the group consisting of
3 acryloyloxy groups, methacryloyloxy groups, and acryloyloxy alkoxy groups and
4 methacryloxyalkyloxy groups comprising an alkyl moiety having from about 2 to
5 about 12 carbon atoms and comprising CH₂ groups, wherein one or more of said CH₂
6 groups independently can be substituted by oxygen, sulfur, or an ester group;
7 provided that at least 2 carbon atoms separate said oxygen or said ester group.

1 61. The method of claim 57 wherein said polymerizable groups are
2 selected from the group consisting of selected from the group consisting of
3 cinnamoyloxy groups, acryloyloxy groups, methacryloyloxy groups, and acryloyloxy
4 alkoxy groups, and acryloyloxy alkoxy groups and methacryloxy alkyloxy groups,
5 and thiol alkoxy groups comprising an alkyl moiety having from about 2 to about 12
6 carbon atoms, said alkyl groups comprising CH₂ groups, wherein one or more of said
7 CH₂ groups independently can be substituted by oxygen, sulfur, or an ester group;
8 provided that at least 2 carbon atoms separate said oxygen or said ester group.

1 62. The composition of claim 55 wherein said polymerizable groups are
2 methacryloyloxy alkoxy groups.

1 63. The composition of claim 55 wherein said terminal functionalities are
2 selected from the group consisting of hydroxyl groups, amino groups, sulfhydryl
3 groups, halogen atoms, alkoxy groups, and spacer groups.

1 64. A composition comprising:
2 a primary polymerizable mesogen comprising a primary nematic to isotropic
3 transition temperature ($T_{n \rightarrow \text{isotropic}}$) and an amount of a secondary
4 polymerizable mesogen comprising a secondary $T_{n \rightarrow \text{isotropic}}$ greater than
5 said primary $T_{n \rightarrow \text{isotropic}}$, said mixture having a curing temperature (T_c)
6 sufficiently low to avoid discomfort during dental procedures;
7 wherein said amount of said secondary polymerizable mesogen is effective to
8 increase said mixture $T_{n \rightarrow \text{isotropic}}$ to a temperature greater than said
9 primary $T_{n \rightarrow \text{isotropic}}$ and to maintain a sufficient difference (ΔT) between
10 T_c and said mixture $T_{n \rightarrow \text{isotropic}}$ to produce a polymerization shrinkage
11 of about 3 vol% change or less.

1 65. The composition of claim 64 wherein said polymerization shrinkage is
2 about 2 vol% change or less.

1 66. The composition of claim 64 wherein said secondary polymerizable
2 mesogen is selected from the group consisting of polymerizable elongated mesogens,
3 mesogenic dimers, and polymerizable mesogens having a $T_{n \rightarrow \text{isotropic}}$ greater than $T_{n \rightarrow \text{isotropic}}$
4 for said primary polymerizable mesogen.

1 67. The composition of claim 65 wherein said secondary polymerizable
2 mesogen is selected from the group consisting of polymerizable elongated mesogens,
3 mesogenic dimers, and polymerizable mesogens having a higher $T_{n \rightarrow \text{isotropic}}$ than said
4 primary polymerizable mesogen.

68. The composition of claim 64 wherein said primary polymerizable mesogen is bis-(4-(6-methacryloyloxy-A-1-oxy)benzoyl)2-(t-butyl) quinone in which A is selected from the group consisting of a alkyl groups having from about 2-9 carbon atoms and mixtures thereof.

69. The composition of claim 68 wherein A is a hexyl group.

70. A composition comprising:

a quantity of a primary polymerizable mesogen comprising bis-(4-(6-methacryloyloxy-A-1-oxy)benzoyl)2-(t-butyl) quinone in which A is selected from the group consisting of a alkyl groups having from about 2-9 and an amount of a decanedioic acid bis-(4-{2-tert-butyl-4-[4-(2-methyl-acryloyloxy)-benzoyloxy]-phenoxy-carbonyl}-phenyl) ester {C0[H,TB,H] (MeAcry)(O) }₂ (seb);

wherein said quantity and said amount are effective to produce curing temperature (T_c) sufficiently low to avoid discomfort during dental procedures;

wherein said amount of said decanedioic acid bis-(4-{2-tert-butyl-4-[4-(2-methyl-acryloyloxy)-benzoyloxy]-phenoxy-carbonyl}-phenyl) ester {C0[H,TB,H] (MeAcry)(O) }₂ (seb) is effective to increase said mixture T_{n->isotropic} to a temperature greater than said primary T_{n->isotropic} and to maintain a sufficient difference (ΔT) between T_c and said mixture T_{n->isotropic} to produce a polymerization shrinkage of about 3 vol% change or less.

71. The composition of claim 70 wherein said polymerization shrinkage is about 2 vol.% change or less.

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1 72. The composition of claim 71 wherein A is a hexyl group.

1 73. The composition of claim 70 wherein said T_c is from about 20 °C to
2 about 37 °C.

1 74. The composition of claim 71 wherein said T_c is from about 20 °C to
2 about 37 °C.

1 75. The composition of claim 72 wherein said T_c is from about 20 °C to
2 about 37 °C.

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